MONTANA UNDERGROUND STORAGE TANK PROGRAM NEWSLETTER

MUST News

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Special Cleanup For Special Gas:

A Demonstration Project

Inside This Issue

The following is a portion of a detailed report on a recently concluded demonstration project led by Jeffrey A. Kuhn and Patrick Skibicki, both of the Petroleum Release Section of the Montana Department of Environmental Quality, and Kenneth R. Manchester, MSE Technology Applications Inc., of Butte, Montana.

Formal title of the report is Electrical Resistance Heating (ERH) Technology Coupled with Air Sparging and Soil Vapor Extraction for Remediation of MTBE and BTEX in Soils and Groundwater in Ronan, Montana. The full report, with more illustrations, is accessible on the DEQ Web site: http://www.deq.mt.gov/LUST/mtbe.asp.

Summary

Gasoline from a leaking underground storage tank in Ronan, Montana, contaminated the soil and groundwater with methyl tertiary butyl ether (MTBE), benzene, touluene, ethylbenzene, xylenes (BTEX), and other compounds.

Complete remediation of the site has been difficult because of fine-grained, glacial silt and clay sediments beneath the site, and because the contaminant plume extends beneath heavily traveled U.S. Highway 93 in western Montana. Common remedial technologies such as soil vapor extraction (SVE) and air sparging were used with moderate effect in reducing contaminant levels. However, a substantial source mass of hydrocarbons located beneath the highway could not be effectively remediated.

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Electrode Installation

Montana Department of Environmental Quality

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Tank Owners Reminder:

You Have To Show Financial Responsibility

Federal and state regulations require that underground storage tank owners be able to demonstrate financial responsibility; that is, the ability to pay for cleanup or third-party liability compensation that results from releases from UST systems.

UST systems with valid operating permits have "partial coverage," $965,000 of the required $1 million coverage because they have access to Petroleum Tank Release Compensation Funds (PTRCF). However, the PTRCF requires a 50 percent co-payment on the first $35,000 of reimbursable remediation expenses, or $17,500.

Inspectors will begin looking for a Certification of Financial Responsibility for the $17,500 in your files in January 2006. The department will be providing education and outreach to inspectors and facility owners between now and then.

Three categories of tanks are excluded from financial responsibility requirements:

1) State and federally-owned USTs;

2) Tanks regulated by Montana that are not within federal UST definitions: heating oil tanks and underground piping attached to above ground storage tanks;

3) Tanks exempted by Administrative Rules of Montana (ARM) 17.56.102, web link: **http://www.deq.state.mt.us/dir/legal/Chapters/Ch56-01.pdf**

An EPA initiative will be ensuring that UST programs nationwide are enforcing financial responsibility requirements. EPA's manual on financial responsibility can be accessed on the web at **http://www.epa.gov/swerust1/pubs/frustman.htm.** ■

Monthly Record-keeping Needs Serious Eye-balling

If you don't have a monthly record in your files – a record that you have examined closely and consciously – you aren't documenting monthly leak detection.

The principle behind monthly leak detection is to test – and critically look – for leaks **monthly**. An automatic tank gauge (ATG) printout showing that there were no leaks within the last year does not document monthly checks.

Getting an ATG history printout after a month or more has passed, will not suffice.

Even automatic and continuous leak detection methods require monthly action. That means a close, methodical, and questioning examination. You must look at the console to ensure it is operational, that all sensors are in communication with the console and that the system is not in alarm.

You must document your monitoring by keeping monthly printouts or by keeping a logbook. ■

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To more aggressively remediate this residual hydrocarbon mass, traditional air sparging and soil vapor extraction technologies were combined with an innovative electrical resistance heating (ERH) technology. Twelve air sparging electrodes, six SVE wells, and eight auxiliary air sparge points were placed under Highway 93 in the source mass area. Temperatures in the treatment volume exceeded 100 degrees Celsius and input power to the electrodes varied between 12 and 17 kilowatts for 142 days. Soil and groundwater samples collected from the treatment zone prior to implementing the ERH demonstration project indicated high residual concentrations of MTBE and BTEX.

Cost per unit volume of soil treatment may be more expensive than traditional technologies such as SVE and air sparging. However, preliminary results indicate that ERH may significantly decrease the lifespan of remediation required to treat fine-grained, petroleum-contaminated-sediments and thus be competitive with current, traditional technologies that require substantially longer time to achieve cleanup requirements.

By way of introduction . . .

The demonstration project combined air sparging, SVE, and electrical resistance heating to remediate a defined volume of soil and groundwater beneath Highway 93 within a larger gasoline plume originating from leaking underground storage tanks (USTs) at George's Conoco. Compounds present in the gasoline released from the operating facility included MTBE and BTEX. The ongoing presence of a significant light non-aqueous phase liquid plume (LNAPL, or gasoline, or free product) has continued to generate a significant MTBE/BTEX dissolved plume. The combination of technologies used at the site targeted the removal of MTBE (a recalcitrant compound in the subsurface) in addition to the other gasoline compounds present in the treatment zone targeted by the ERH technology.

In April 1994, a 16,000-gallon underground storage tank (UST) of premium gasoline catastrophically failed. Inventory records indicated that more than 2,000 gallons of gasoline was released to subsurface within a short time. Tank-closure forms indicated that perforations and cracks were observed in weld seams and were suspected to be the cause of the subsurface release.

In May 1995, 2.5 feet of free product was detected in a piezometer installed by the city of Ronan along the west right-of-way portion of Highway 93. Subsequent investigations revealed that an LNAPL plume present on groundwater directly west of the UST basin area, had migrated under Highway 93. Based on the size of the UST and the extent of the free product plume, it was estimated that approximately 4,000 to 6,000 gallons of gasoline may have been released to the environment.

The dissolved-phase contaminant plume currently extends southwest from the release area to Spring Creek, a perennial spring-fed stream located approximately 1,500 feet west of George's Conoco. The water table aquifer beneath the site is shallow, ranging in depth from 2 feet below ground surface (bgs) near Spring Creek to 18 feet beneath Highway 93. The dominant rock characteristic encountered in project boreholes is silt and fine sand. Significant clay layers exist in the upper 10 feet and at about 40 feet bgs. The lithology is typical of glacial lake-bed deposits common to the Flathead Valley in which the site is located.

Since discovery of the contamination, various technologies have been used to remediate the site. Free product skimmers were first deployed in the source area to begin the removal of the free product plume. Additional project recovery wells and an 80-foot air sparging cut-off trench were installed in the west side of the highway to stop the advance of the free product plume. Combined vacuum-assisted free product recovery and in-well sparging operations were later installed to enhance free product recovery.

Through June 2003, 224 gallons of gasoline were removed by passive canisters, 1,863 gallons by skimmer pumps, and 1,369 gallons by SVE/in-well sparging for a total of 3,456 gallons. Since October 2001, no measurable free product has been detected in the original free product plume footprint. However, significant residual contamination still exists within the smear zone. Slant Geoprobe borings completed in April 2003 verified high residual petroleum contamination in the proposed treatment area and supported the decision to proceed with the demonstration project.

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Enter ET-DSP

The trademarked technology known as ET-DSP, an electrically resistive heating technology, is owned by the McMillan-McGee Corporation of Canada, supplier of computer-controlled three-phase power to a designed grid of buried electrodes within a defined treatment volume. The technology has been used at various locations to successfully remediate sites contaminated with volatile organic compounds, but had not been previously used where MTBE was present. In the laboratory, bench scale testing determined that air sparging and SVE coupled with ET-DSP was effective at removing dissolved MTBE in water. Coupling air sparging with the ET-DSP had not been demonstrated on a field scale where MTBE was one of the principal contaminants. The George’s Conoco site offered an ideal location to test the combined technologies and evaluate its effectiveness at the removal of MTBE and other gasoline compounds.

Static and dynamic resistivity tests found the soils in the project site suitable for electrical resistance heating. An electrode array was designed including 12 specially designed air sparging electrodes, six soil vapor extraction wells, and eight auxiliary sparge points.

Each of the electrodes designed for the project were 10 feet long, 8 inches in diameter, and of thin-walled steel pipe capped at both ends. The electrodes were in three sections, upper, middle and lower, divided by internal packers. Each section was slotted in the steel casing to allow water and/or air to pass through into the surrounding formation. The upper and middle zones of the electrodes were configured for water injection and lower section was designed for air sparging.

Pre-demonstration sampling; system layout

Additional soil and groundwater samples were collected during installation of remediation systems, augmenting samples collected in April 2003, the initial field characterization samples.

Placed in connecting trenches across Highway 93, to the westside equipment building area were all piping, wiring, and tubing for the electrodes, SVE wells, DigiTAMs, that is, string instruments that measure and record temperatures at various subsurface depths, and sparge points. A 20-foot long, by 18-inch diameter culvert was placed in the primary, east-west trench before completing the west side project area. Twenty individual air lines were run to the eastside equipment building for connection to their air sparging compressors. Eight SVE lines were run to the SVE blower unit, and 12 sets of electrical leads and water hose were directed to the power delivery system (PDS) area.

Electrodes in operation

On July 11, 2003, the electrodes were energized and SVE operations following on with soil vapor extraction operations started four days later on July 15. Air sparging did not start during the early, heating stage to allow the soil and groundwater to increase in temperature to approximately 60 degrees Celsius before sparging systems were activated. During the initial phase of electrode operation, the amount of electrical energy transferred from electrodes to the soil was highly variable. To help maintain conductivity of the soil, salt was added to the water tank supplying water to the electrodes on a routine basis through the demonstration.

Water injection to all the electrodes was maintained throughout the project to facilitate power transfer into the soil and to assist with heat transfer in the subsurface material. Over the course of the project, 142 days, a total of 111,008 gallons of water were injected through the electrodes, equating to an average injection rate of 0.05 gallons per minute per electrode.

Power to the electrodes was shut off on November 30, 2003. A total of 514,120 Kw were used during the project to heat the soil and groundwater and maintain temperatures. Input power to individual electrodes varied between 12 kW and 17 kW.

Air sparging

Initial tests on the effects of air sparging on the electrodes indicated a more sophisticated controller could be installed on both systems allowing programmable pulsed air sparging. A fairly conservative, pulsed sparging schedule designed to avoid disruption of power to the electrodes started October 8, 2003. Each zone, consisting of two electrode zones and four auxiliary sparge zones, was sparged for one hour with a two-hour break between electrode sparge zones and a one-hour break between

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auxiliary sparge zones. More aggressive air sparging was later implemented when the treatment zone reached temperatures higher than 90 degrees Celsius. This schedule was maintained through the end of November when the electrodes were shut off and continued into mid-December when post-demonstration soil and groundwater sampling occurred.

Soil vapor extraction

The SVE capture system installed for the technology demonstration was operated nearly continuously throughout the demonstration. Routine measurements of contaminant concentrations in the SVE exhaust were made using either a MiniRae or PhotoVac MicroTikp photo-ionization detector (PID) as a means to measure hydrocarbon removal rates cost effectively. Periodic tedlar air bag samples were collected from the SVE exhaust port for laboratory analysis to document actual hydrocarbon concentrations in the exhaust stream. Over five months, between July 11 and December 15, a total of 1,574 kg, about 560 gallons, of gasoline were removed from the treatment area under the highway.

Results

Soil and groundwater samples were collected from the treatment zone in December after the power was shut off from the electrodes. Analysis indicates dramatic decreases in contaminants throughout the treatment area at the end of the demonstration period. Before the ET-DSP demonstration was conducted, groundwater contaminant concentrations in the treatment volume ranged from 13,000 to 165,000 micrograms per liter total purgeable hydrocarbons (TPH). MTBE concentrations ranged from a low of 980 micrograms per liter to a high of 58,700 micrograms per liter while benzene concentrations ranged from 1,470 to 28,500 micrograms per liter. Groundwater samples collected at about the same locations in mid-December 2003, approximately two weeks after the ET-DSP system was turned off, had only trace amounts of gasoline compounds well within state water quality standards known as WQB-7. MTBE and BTEX concentrations were all below detection levels with one exception. The highest TPH concentration was 35 micrograms per liter, well below the proposed risk-based screening level (RBSL level of 1,000 micrograms per liter.

Conclusions

- Post-demonstration soil and groundwater samples collected from the same general pre-demonstration sampling locations found contaminant concentrations reduced to non-detect or slight above detection levels.

- ERH can be successfully implemented under major highways or other public areas with minimal disruption to the public. A total of 1,574 kg, or 560 gallons, of gasoline was recovered from under the highway over the course of the demonstration despite the fact that relatively aggressive remedial systems were employed along both sides of the highway prior to the project.

- Air sparging, when used in conjunction with ET-DSP, has a positive effect on the volatilization and removal of contaminants. Contaminant concentrations in the SVE exhaust increased dramatically immediately following the start of air sparging operations. Air sparging operations had significant effects on the electrode operations and temperature distribution in the treatment zone. Sparging through the electrodes caused a drop in the amount of electrical current being passed into the ground, likely because of the drying action of the air passing through the formation. Sparging activity caused sharp temperature swings in the DigiTAM monitoring strings, indicating that liquids and gasses were being pushed around in the subsurface, likely assisting in the volatilization and removal of contamination.

- Continuous air sparging was unnecessary. Pulsed sparging for one-to-two hours per zone, twice daily, appeared to be effective. The use of both sparging electrodes and individual sparge points along with programmable air flow controllers in the system design provided flexibility in air sparging operations.

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- Total cost of the demonstration was $360,000, including actual costs, in-kind services, and other funding. With a treated volume of 2,771 cubic yards, the cost to treat a cubic yard was $130. ■

Questions?

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Montana Petroleum Marketers And C-Store Association Gather In June

Leon Westbrock, executive vice president and chief operating officer for CHS Energy of Inver Grove Heights, Minnesota, will deliver the industry keynote address at the annual convention of the Montana Petroleum Marketers and C-Store Association convention June 14-16 in Billings.

The convention and trade show, at the Holiday Inn Grand, also features a retail workshop by Betsi Bixby under the theme, "Hypermarket Survival Strategies."

Westbrock's speech is scheduled for 3:30 p.m., June 15. In his current position, Westbrock is responsible for CHS refineries, pipelines, refined fuels sales, marketing and distribution, lubricants and propane. In addition, he serves on the boards of the National Cooperative Refinery Association and Universal Cooperatives.

CHS Energy fuels and lubricants are marketed under the Cenex® brand as well as under private labels through other businesses. The firm is the third largest U.S. propane retailer. Along with operating 1,200 miles of pipeline, Cenex owns a refinery in Billings and has a partnership in a Kansas refinery. Cenex fuels are sold at more than 1,600 retail outlets, including Cenex convenience stores. ■

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MONTANA PETROLEUM MARKETERS

&

C-STORE ASSOCIATION CONVENTION

Holiday Inn Grand • Billings, Montana
June 14-16, 2005

Workshop
by Betsi Bixby
under the theme
"Hypermarket Survival Strategies"

Law Amended On Compliance Enforcement

HOUSE BILL 78, SIGNED INTO LAW APRIL 18, 2005, amends a section of state law to eliminate full compliance as the measure for pursuing enforcement. In effect, the amended law will permit the DEQ's Underground Storage Tank Section to apply compliance assistance for less significant violations.

The department currently is drafting rules to implement the changes. ■

Web-based Training In The Works For Owners And Operators

One of the comments the UST Section hears from owners and operators is, "We don't understand what you want from us."

Montana's UST Program is creating a web-based training program for owners and operators of underground storage tanks. The training will include information on general underground storage tank equipment, leak prevention, and regulatory compliance. Most significantly, the training includes an interactive questionnaire that, when completed, will provide owners and operators with *facility-specific* compliance plans. From this training, an O/O should be able to:

- identify his or her facility's tank and piping composition, size, contents and purpose;
- identify which forms of leak prevention are employed for each tank and product line;
- identify the components of leak prevention equipment and how they work;
- identify which forms of leak detection are employed for each tank and product line;
- identify components of leak detection equipment and how they work;
- identify the forms of spill protection and overfill prevention are employed at their facility;
- reference the best management practices for the operation and maintenance of those specific pieces of equipment; and
- understand UST permitting and inspection requirements generally.

The new, web-based training is expected to be available by mid- to late-summer this year. ■

If you would be willing to help test the Owner/Operator Training, please contact Ben Thomas Associates, toll free at 1-866-301-8265

Inspectors Can Get EPA Training Online

The Environmental Protection Agency has completed an Underground Storage Tank Inspectors Training Course and posted it on the web at **http://www.neiwpcc.org/oust1.html**.

This free course is designed for inspectors, but provides a great learning experience for anyone who wants to learn about UST equipment and its operation and maintenance.

The Montana UST Section offers eight hours of continuing education credits for installers, removers and inspectors who complete the EPA web-based training and present the certificate of completion to the department. The certificate must be presented to the department before the applicable license expires. ■

Two Appointments Pending For Petro Board

A slight change in the background of one member of the Petroleum Tank Release Compensation Board – yet to be appointed – has been authorized by the Montana Legislature.

The Legislature approved a bill initiated by the Board, SB145, to require that one of its members be a person with a background in environmental regulation.

An established board position, representing the financial or banking industry, becomes vacant June 30. Both the new position and the vacant, established one are expected to be filled by gubernatorial appointment after July 1.

To apply or recommend someone for Board membership, use the Web site: **http://pp.discoveringmontana.com/appoint/** or contact Patti Keebler, phone: 406-444-3111, or e-mail: pkeebler@mt.gov. ■

Missoula Man Newly Appointed To Petro Board

Thomas Bateridge of Missoula has been appointed by Governor Brian Schweitzer as the newest member of the Montana Petroleum Tank Release Compensation Board.

Bateridge will serve a term ending June 30, 2006. He replaces Terry Cosgrove of Helena who resigned.

Bateridge, a water resources consultant for 25 years, is a graduate of both The University of Montana and Montana State University. He holds a master's of science degree in geology and soils science. ■

The Holes In Our UST Systems

by Marcel Moreau
From LUSTLine Bulletin 30
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I used to sleep soundly at night. I used to believe that the leaking underground storage tank (LUST) problem had a technological solution that could overcome human frailty. I have long been, and still remain, an ardent proponent of secondary containment systems for petroleum storage. I have for a long time thought that secondary containment, though not perfect, would adequately protect our environment from petroleum contamination. A few months ago, however, I had a rude awakening.

A troubling case

The newspaper headlines announced bluntly that MTBE (methyl tertiary-butyl ether) had been found in a monitoring well located between a gas station and a public water supply well that serves several thousand people.

The news reports indicated that a new convenience store/gas station facility, barely 10 months old, had reported that MTBE had been found in an observation well in the tank backfill. The site had no previous history of gasoline storage. The storage facility was state-of-the-art, with double-walled fiberglass tanks and flexible piping, dispenser sumps, tank top piping sumps, and spill containment and overfill prevention. Only the Stage I vapor recovery riser and Stage II vapor return piping were single-walled. Sensors continuously monitored the piping sumps and tank interstitial spaces for evidence of releases.

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As part of a due diligence investigation associated with a property transfer, samples that had been taken from the facility's observation wells tested positive for MTBE. Because of this, a monitoring well some 1,000 feet away that was halfway between the convenience store and the public wells was also sampled. This well also tested positive for MTBE. Soon low levels of MTBE appeared in the nearby public water supply well. As a result, that well was closed, and an alternate well a few hundred feet farther away was put into operation.

Where's the leak?

Immediately, the search was on for a leak. Multiple tightness tests of tanks and piping showed nothing. Interstitial spaces of tanks and piping were dry. Was it a vapor leak? A helium test, where the storage system is filled with helium and then a helium detector is used to check for leakage, was conducted and, at first, indicated a positive result. Helium levels in the area over the tank, as measured through holes in the concrete cover pad, were higher than expected. To pinpoint the leak, the concrete mat over the tanks was sawed into large blocks and then carefully lifted off and removed. The gravel backfill over the tanks was vacuumed away so as to leave the piping as undisturbed as possible.

With the tank top and piping exposed, the helium test was repeated. This time, the helium detector was placed right up against the joints and the piping so that the exact location of the leak could be identified. Quite a few interested parties were watching, including the state environmental agency, the tank installer, and several representatives of the tank owner. But no leak was found. A dead-end again.

Spillage perhaps?

A review of inventory records provided a clue. There were four instances where the records provided strong indications that the regular tank had been overfilled. This was evidenced by a shortage of several hundred gallons in the regular product inventory, while the premium product showed an overage of similar magnitude.

The most likely scenario was that more regular product had been ordered than could fit into the tank, so the excess was delivered into the premium tank. This is known in the trade as "cross-dropping." The reason excess product had been ordered was perhaps because the fuel manager failed to recognize that the "10,000-gallon tank" had an actual maximum capacity of 9,728 gallons. This volume was further reduced by a float vent valve that had been set conservatively at 18 inches below tank top, yielding an actual tank capacity of only 8,459 gallons.

Given the operational characteristics of float vent valves, it seems likely that the delivery person would have to have dealt with a hose full of product and that some spillage could have resulted.

By what route?

The spill containment manholes at this site were below-grade models, which are good in terms of keeping surface water out, but leave some gravel exposed around the rim of the spill container. Product could have infiltrated this backfill area. But then why was there no significant presence of any other gasoline constituents in the groundwater in the tank excavation and no evidence of contamination in the gravel backfill around the fill pipe?

For this scenario to be credible, we must assume that the other gasoline constituents volatilized and biodegraded, while the MTBE was carried by precipitation down to the groundwater. Because the backfill was clean and well aerated, and the investigation of the site occurred about five months after the last clear indication of an overfill incident in the inventory records, this scenario seems somewhat plausible.

Another possible route for MTBE contamination is being explored by Dr. Gary Robbins at the University of Connecticut. Robbins is finding that MTBE is appearing in groundwater beneath dispensing areas, apparently originating with spillage during vehicle fueling. Because of its solubility, MTBE can be transported by rainwater to groundwater while other gasoline constituents are attenuated or volatilized. It is possible that surface spillage at the dispensers could have contributed MTBE contamination to our mystery spill as well.

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A bit of history

Until the publication of the EPA's tank testing study in 1988, a leak rate of 0.05 gallon per hour had been the longstanding industry standard for leak detection accuracy. This number apparently originated with a study that concluded that leaks of 0.05 gallon or less assimilated naturally and did not pose a significant contamination threat. While the actual magnitude of a "no-adverse-effect leak rate" could be debated at great length, I think the presence of MTBE in today's motor fuels would add a new dimension to the equation.

The incident cited above, as well as several others that I am aware of involving significant MTBE contamination resulting from automobile accidents, where limited amounts of fuel were spilled, casts a new light on the significance of gasoline spillage. Volumes of spilled gasoline that previously would have had no adverse effects can cause significant damage when MTBE is present.

While the official EPA position is that there is no "allowable" leak rate, the evaluation protocols for the various leak detection methods determine threshold leak rates below which a storage system is assumed to be tight. The nagging question is whether a leak detection standard of 0.2 or 0.1 gallon per hour is adequate to protect human health and the environment when MTBE is present.

What does the future hold?

While we are no doubt better off from a leaking storage system perspective today than we were 10 years ago, we are not out of the woods yet, and probably never will be. In the next decade we will likely still be paying for some sins of the past decade, will still be dealing with the foibles of human nature, and will be facing an ever more prevalent chemical specter with the initials MTBE.

So what possible routes of escape might gasoline and its constituents (MTBE in particular) find in our future fueling systems? Here are some working hypotheses that I think are worth keeping in mind:

There are holes in our UST systems, but they are below the detection threshold for leak detection technology.
One of my favorite stories involves a double-walled fiberglass tank. During a routine regulatory inspection, the regulator discovered that the interstitial sensor had been disconnected. A subsequent investigation revealed that the interstitial space was half full of product, which explained why the sensor had been disabled.

The owner insisted that there was no problem, suggesting that a delivery had mistakenly been made into the interstitial space and pointing to several tightness tests with "tight" results. The product was pumped out of the interstitial space, yet a small amount of product, about a gallon every couple of days, kept reappearing. This was initially explained as residual product draining from inside the ribs of the tank, but the product continued to mysteriously accumulate.

The owner insisted that everything was fine, but the environmental agency was suspicious. Finally a dye was introduced into the product in the tank, and a few days later, the dye appeared in the product that was being removed from the interstitial space. Subsequent internal inspection uncovered a pry bar lying in the bottom of the tank at the fill opening, and a small impact fracture just beyond the edge of the striker plate in the bottom of the tank. A likely scenario is that a delivery driver, in the process of chopping ice out of the spill container (after removing the fill cap), had slipped and dropped the bar down the fill pipe.

The point is that this leak would never have been detected had it not been for secondary containment (the leak rate was less than 0.1 gph), but clearly could have resulted in the release of a significant amount of product over time. In another recent case, a tank gauge had apparently failed to detect a leak that had gotten into some underground utilities. Review of the automatic tank gauge (ATG) test records indicated a small, consistent loss—evidently not enough to exceed the leak threshold for the device and fail a leak test.

There are holes in our UST systems, but we are not looking in the right places for them.
Leaks of petroleum vapors from UST systems have not been a traditional target of leak detection efforts, and it may well be that historically the magnitude of these releases has been below the "no-adverse-effect leak rate." Although I do not yet know of any instance where a

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vapor release has been the source of an environmental problem, theoretical considerations indicate that it could be a possible origin for MTBE contamination. The potential magnitude of vapor releases has been increased by the widespread use of pressure/vacuum vents that maintain a small pressure on the vapor space of the tank, thus increasing the rate of vapor emissions from any holes near the top of the tank.

Of the leak detection tools at our disposal, only full system tightness testing and soil vapor monitoring are likely to detect vapor leakage from storage systems. Soil vapor monitoring is rarely used and tank tightness testing will be phased out with inventory control. Storage systems that are subject to Stage II vapor recovery regulations are subject to periodic tightness testing of the vapor space, but these are a relatively small percentage of the tank population at this time.

So, for a great many storage systems, the tightness of the tank ullage space and the piping that handles only vapors is never determined. Other storage system components that escape routine testing are the piping sumps on top of tanks and dispenser sumps.

While sumps that contain some amount of water are a fairly common sight, I always wonder whether the sumps that don't contain water are dry because no water is getting in or because whatever water is getting in is also leaking out. As sumps age and are subject to frost action, possible tank movement, and assorted maintenance activities, it would seem reasonable that, at some point, they could develop holes that would compromise their leak detection role. Yet sumps are not routinely evaluated for liquid tightness.

There are holes in our UST systems, but the technology to detect them is not being installed properly.
Recently, I heard of a case where secondary containment piping had been installed, but leaked product failed to make its way back to the piping sump where the sensor lay in wait to detect it. If leak detection technology is not properly installed, it may not operate properly. This problem, of course, can result in undetected leaks.

There are holes in our UST systems, and they are being detected, but no one is paying attention.
The routine disregard of alarm signals by facility personnel is a problem of epidemic proportion. I recently heard of a facility where the ATG recorded that an alarm indication had been turned off 47 times in 28 days. This problem is twofold in that false alarms that result from poor equipment design or installation occur too frequently, and facility personnel have not been made sufficiently conscious of the potential significance of an alarm going off.

There are no holes in our UST systems, but product is being spilled during deliveries.
As illustrated by the story at the beginning of this article, spill events associated with deliveries continue to occur and can result in significant environmental problems, especially when MTBE is involved. A number of factors contribute to this problem, including the owner's lack of awareness of actual storage tank capacity, the ineffectiveness of the overfill prevention technology we commonly use and the delivery personnel's financial incentive to be quick rather than careful (especially those who are paid by the truckload, not by the hour).

There are no holes in our UST systems, but product is being spilled during dispensing.
The possibility that routine spillage of gasoline by the end user is a significant source of gasoline releases is very disconcerting. Since talking with Gary Robbins about his research, I have begun to notice that evidence of gasoline spillage is everywhere—concrete mats around dispensers, fast-food restaurant parking lots, and on-street parking areas all display ample evidence of how often end users spill gasoline. (Did you ever stop to think why the area around dispensers is paved with concrete and not asphalt? Because we learned long ago that asphalt is rapidly degraded by spillage during fueling.) Historically, this spillage may have been of little consequence because of volatilization and biodegradation, but again, the introduction of MTBE has changed this picture.

The mathematics of consumer spillage looks something like this: In 1997, we, as a nation, dispensed about 126 billion gallons of gasoline. If we assume that the consumer purchases an average of 10 gallons per fuel

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dispensing event and that one in 1,000 fueling operations results in the spillage of one cup of gasoline (that's an individual driver spilling one cup about every 19 years if you fill up once a week), then about 750,000 gallons of fuel are spilled every year at fueling facilities alone. Is this a number we can live with? Is this a number we can live with if MTBE is part of the picture?

The watchword

So here are some watchwords we should keep in mind for the next decade:

- **Out of sight must not be out of mind.**
  Tank management must be an active and ongoing process on the part of tank owners and operators.

- **Do it right!**
  Proper storage system installation and maintenance work is more important than ever.

- **Early retirement is not an option.**
  The tank regulator's job is far from over. I'm also considering the possibility that the most intractable part of the underground petroleum storage problem may prove to be sociological rather than technological: Can we complete 15.75 million underground tank filling operations and 12.5 billion automotive fueling operations each year without spilling a drop?

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